SAMPLING AND ANALYSIS PLAN
For
Holoflite Processor Soil Drying Process
Hazen Research, Inc.

Glass Furnace Technology Demonstration

Prepared by:

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1.0 PROJECT DESCRIPTION AND ORGANIZATION

Tetra Tech EM Inc. (Tetra Tech) is supporting the U.S. Environmental Protection Agency (EPA) with a Superfund Innovative Technology Evaluation (SITE) program demonstration of the Glass Furnace Technology (GFT) to remediate (or remove) polychlorinated biphenyl (PCB) contamination from dredged river sediments.

This document is the sampling and analysis plan (SAP) that describes procedures for conducting sampling at the Holoflite Thermal Processor® bench-scale dryer. The remainder of this section describes the projects purpose and objectives and the project management organization. Subsequent sections describe the field sampling procedures (Section 2.0), testing and measurement protocols (Section 3.0), quality assurance and quality control (QA/QC) checks (Section 4.0), and a proposed schedule for collection of samples (Section 5.0).

1.1 PURPOSE AND OBJECTIVES

This is a demonstration and evaluation of the GFT's ability to destroy or remove polychlorinated biphenyls (PCBs) from dredged-and-dewatered river sediments and to produce an aggregate product that meets the criteria for beneficial reuse. For this project, about 60 cubic yards of river sediment were dredged and dewatered from the Lower Fox River.. These sediments will be dried to a moisture content not to exceed 10 percent in a bench-scale dryer located in Golden, Colorado, and a commercial dryer. The dredged, dewatered, and dried sediment will then be introduced as feedstock to a prototype glass furnace to be constructed for this evaluation in Wisconsin. The sediment will be analyzed for contaminants of concern (COCs) before and after treatment in the bench-scale dryer, and again, before and after processing through the glass furnace. COCs include PCBs, dioxins/furans, semi-volatile organic compounds (SVOCs), and metals. The COC concentrations in the aqueous condensate and flue gas streams from the dryer and the COC concentrations in the resultant glass aggregate product, the furnace flue gas exhaust, and the quench water from the glass furnace will also be measured.

The SITE program demonstration will be conducted at two locations: 1) the soil drying process will be evaluated at the Hazen Research, Inc. (HRI) in Golden, Colorado; and 2) the GFT will be evaluated at Minergy's facility in Winneconne, Wisconsin. This technology evaluation is being conducted by the U.S. Environmental Protection Agency (EPA) National Risk Management Research Laboratory (NRMRL) Superfund Innovative Technology Evaluation (SITE) Program in cooperation with the Wisconsin Department of Natural Resources (WDNR).

1.1.1 GFT Project Objectives

The following objectives are considered critical to the success of the evaluation of the GFT.

- ? To determine the removal efficiency (RE) of polychlorinated biphenyls (PCBs) in the GFT in dredged-and-dewatered river sediments
- ? To determine whether the GFT aggregate product meets the criteria for beneficial reuse under relevant Federal and State regulations
- ? Determine the unit cost of operating the GFT to treat dredged-and-dewatered river sediment
- ? Quantify organic and inorganic contaminant losses resulting from the bench-scale drying process used to dry the dredged-and-dewatered river sediment
- ? Characterize organic and inorganic constituents in all GFT process input and output streams

1.1.2 Holoflite Thermal Processor® Objectives

An important question associated with the GFT process is whether PCBs and other matrix contaminants are lost during the drying process. One objective of this demonstration is to quantify these losses based on statistically-collected samples before and after the drying process. The results from the drying process will be used to estimate potential loss of COCs associated with the pilot-scale dryer.

1.2 PROJECT ORGANIZATION

Tetra Tech and its subcontractors will conduct the bench-scale sediment dryer sampling on behalf of EPA's National Risk Management Research Laboratory, Cincinnati, Ohio. This project will be coordinated with WDNR and Minergy Corporation. The project management team for the bench-scale sediment dryer sampling is summarized below.

NAME	TITLE/RESPONSIBILITY	TELEPHONE
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Robert Paulson	Wisconsin Department of Natural Resources Project Manager	(608) 266-7790
Terry Carroll	Minergy Corporation Point of Contact	(920) 727-1411
Tom Baudhuin	Minergy Corporation Manager of Engineering	(920) 727-1424
Martha Maier	Paradigm Laboratories (PCBs/dioxins/furans and SVOCs) Point of Contact	(910) 350-2839
Steve Hall	Kiber Laboratories (SVOCs and metals) Point of Contact	(404) 636-0928
Dennis M. Johnson	Hazen Research, Inc. Point of Contact	(303) 279-4501

2.0 SAMPLING

This section describes procedures for mixing the drummed sediments in Hazen's feed hopper, sampling from 5- to 7-gallon buckets of feed material, support facilities for sampling the flue gas from the dryer, sampling the heating oil, flue gas sampling procedures, and sampling procedures for sampling the treatment condensate. In addition, this section includes a summary of the project health and safety plan and procedures for managing investigation-derived wastes (IDW).

2.1 SAMPLING POINTS

The sediment for this demonstration was removed from the Lower Fox River as a result of another WDNR demonstration project (at sediment waste management unit [SMU] 56/57), which included hydraulic dredging, on-shore dewatering, filter pressing, treatment with lime, transporting, and disposing of PCB-containing sediments. A portion of the sediment from the SMU56/57 project was segregated for the purpose of evaluating innovative sediment treatment technology. Instead of loading dewatered and lime-treated sediment into trucks for transport and disposal, front-end loaders loaded sediment into four, 20-cubic-yard, lined roll-off boxes. The boxes were covered with tarps and placed in the East Brown County Landfill, Wisconsin.

On August 5, 2000, these boxes were mixed with a backhoe, and the mixed sediment was placed in four 55-gallon drums. The drums were sealed, placed on wooden pallets, and banded for shipment to HRI for processing through the Holoflite Thermal Processor® dryer.

2.1.1 Sediment Mixing

Of the four drums delivered to Hazen for the pilot test, one was used to test a different drying method involving a quartz batch kiln, one was dried in a drum dryer, and two drums currently remain unmixed. Based on Hazen's pre-test experimentation with the sediments and the Holoflite Thermal Processor® dryer, it was determined that the sediments containing approximately 50% moisture would not flow through properly. Therefore, one drum was sampled using a post-hole digger to collect a representative sample through the entire vertical extent of the drum, then dried in a drum-dryer. The sampled sediment was collected in a sealed 5-gallon bucket. A composite sample will be collected for laboratory analysis from the

5-gallon bucket during the pilot test.

Three drums will be used in the performance of the pilot test, the drum-dried sediment and the two unmixed, undried drums which will be mixed together. The drum-dried sediment will need to be crushed in a roll crusher to facilitate blending. The roll crusher consists of two closely-spaced rollers which break up the material as it passes through. The drum-dried sediment will be blended by coning, quartering, and repiling the sediment three times using shovels on an impervious surface. The unmixed, undried drums will be blended separately using the same coning and quartering methods.

Mixing of the drum-dried and unmixed, undried sediment will take place prior to introduction into the Holoflite Thermal Processor® dryer. Blending of the dried and undried sediment will be accomplished using a pug mill. A pug mill is a 4-foot long blending and mixing machine with two counter-rotating horizontal shafts fitted with off-set paddles to break lumps and blend material. The material will be fed into the pug mill at a ratio of three parts moist to one part dry, based on the results of earlier tests. After the material has been blended, it will be spread out in a circle, and 5- to 7-gallon buckets will be filled by taking shovel samples from various points around the edge of the circle. This method of sampling will continue until all material has been placed into the buckets.

Once the sediment has been mixed, it will be processed through the Holoflite Thermal Processor® dryer. The sediment will be run through the dryer continuously, beginning with a 2-3 hour warmup period. Batches (or runs) will consist of time periods based on the residence time of the material in the dryer. The drying of each batch will equal a “run”. The through-put for the dryer is about 5 to15 pounds per hour, equating to one batch per each one- to three-hour period; eight batches will be processed in three days.

2.1.2 Sediment Sampling

Three pre-dryer samples of the sediment will be collected with dedicated, disposable samplers and mixing containers from each of eight batches before input into the dryer. The three samples will be combined to form a single composite sample for each run. The concentrations of COCs will be determined for each composite sample. Three post-dryer composite samples of the dried sediment from each of the same eight distinct runs will also be collected after discharge from the dryer, and combined into a composite sample. The COCs concentrations will again be determined. The sample data will therefore consist of 16 pre- and post-dryer treated composite samples, collected across eight experimental runs.

An F-test statistic will be used to determine if there is a statistically significant treatment (i.e., dryer) effect at the 0.05 significance level. The estimated difference between the post- and pre-treatment mean concentration will then be used to estimate a geometric mean for COC loss. The calculated standard error of the estimated difference between the post- and pre-treatment log means will then be used to construct a 95% confidence interval, and this confidence interval will be back transformed to produce an equivalent 95% confidence interval for COC loss.

2.2 FLUE GAS SAMPLING

Flue gas sampling will be conducted on the exhaust from the Holoflite Thermal Processor®. Oxygen, carbon monoxide, and carbon dioxide in the exhaust from the drying process will be measured using EPA Method 3 (ORSAT analyzer). The samples collected during each run will be analyzed to determine what, if any, PCB, dioxins/furans, semivolatile organics (SVOC) or metals, are lost during the drying process. The following sections contain a summary of the air analysis procedures and support equipment required to perform the sampling.

2.2.1 Sampling Train Assembly

Suitable laboratory space for assembly of sampling trains and for performing sample recoveries and other activities will be provided by Hazen. Condensate samples and sediment samples will be collected and stored in a refrigerator or packed in an ice cooler. Air samples will be stored according to procedures specified in each method until shipment to the selected laboratory.

2.2.2 Flue Gas Sampling Procedures

In order to meet the objectives of this testing program, the data from each sampling method must be performed in accordance with the specified methodology and will comply with the QA/QC requirements outlined in the QAPP. To assure that program objectives are achieved, sufficient sample volumes must be collected and laboratory minimum detection limits must be met to enable calculation of the fate of the contaminants of interest. For flue gas measurements, the detection limit of a given method is a function of the analytical detection limit and the total sample collected in the sampling train. All sampling trains will be operated for the time periods specified in Figure 5.2, to allow collection of as much sample as possible, based on the methodology and the limitations presented by the stack conditions.

Several site-specific conditions during sediment drying will require modifications to the standard sampling methods to achieve the project's quality assurance objectives. Volatilization of compounds with low vapor pressures or boiling points below the drying temperature are the only species expected to be collected. Therefore, the low concentration levels of many organic compounds will require extended run times in order to collect measurable quantities of the selected pollutants. The high moisture content of the process stream will be collected in the condensing system and should not effect the collection of the flue gas samples. The condensate will be collected and analyzed as a separate process stream. The non-condensable flue gas will be sampled for metals, including mercury, SVOCs, and for dioxins/furans and polychlorinated biphenyl congeners only. Since no oxidation of the organic constituents in the sediment or combustion in the dryer should occur, samples for volatile organics, HCl, and Cl_2 will not be collected. Sampling of these analytes would not be possible as the entire available flue gas volume from the bench-scale unit will be sampled during the collection of each sampling train. The duct for the non-condensable gas stream will be less than four (4) inches in diameter. Therefore, given the low volume of flue gas and the small diameter of the duct, a sample of flue gas will be collected between sampling runs using a Tedlar bag. These bagged flue gas samples will be used for the determination of CO, CO_2, and O_2 using an ORSAT analyzer, although ambient conditions are anticipated.

2.2.3 Aqueous Samples

Any condensate generated during the drying process will be collected and sampled for PCBs, dioxins/furans, semi-volatile organics, and metals. A batch of sediment should generate approximately 7-8 gallons of liquid. This material is collected in a condensate trap, as a part of the flue gas exhaust system. A grab sample will be collected from this trap, about the middle of the batch duration, from the condensate trap. Therefore, 8 condensate samples will be collected and analyzed for metals, SVOCs, PCBs, and dioxins/furans.

2.2.4 Heating Oil Samples

A sample of the oil used in the closed loop heating system will be collected before and after the process. This sample will be analyzed for metals, SVOCs, PCBs, and dioxins/furans. Only the two samples (before and after the process) will be collected and analyzed.

2.3 SUMMARY OF ANALYSIS

Table 2-1 summarizes the sample runs and procedures for the Holoflite Thermal Processor®. Details of the sample trains, sampling procedures, and recovery procedures are discussed in QAPP.

TABLE 2-1. SAMPLING RUNS AND PROCEDURES

Sediment Sampling Parameters during the Drying Process

PARAMETER	EPA METHOD	NUMBER OF SAMPLES
PCBs (congeners) and Dioxins/Furans	8290A	14/9*
Metals, including Mercury	3020A/6010B/7470A	14*
Semi-Volatile Organics	3540C/8270C	10*

* 6 batches (composite) input to dryer and 6 batches (composite) output from dryer and one duplicate of each (PCBs and metals)

Flue Gas Sampling and Analytical Parameters during the Drying Process

PARAMETER	EPA SAMPLING METHOD	EPA ANALYTICAL METHOD	NUMBER OF SAMPLES
PCBs (congeners) and Dioxins/Furans	23	8290A	6
SVOCs	0010	3540C/8270C	6
Metals, including Mercury	0060	0060/6010B/7470A	4
O_2, CO_2, CO (if possible)	3	ORSAT analyzer	16

Aqueous Sampling (Condensate) Parameters during the Drying Process

PARAMETER	EPA METHOD	NUMBER OF SAMPLES
PCBs (congeners) and Dioxins/Furans	8290A	6/4
Metals, including Mercury	3010A/6010B/7470A	4
Semi-Volatile Organics	3520C/8270C	4

QA Samples

MATRIX/PARAMETER	TYPE OF QA SAMPLE[1]	NUMBER OF SAMPLES
Sediment PCBs and Dioxins/Furans	Field Duplicate/MS/MSD	2/1/1
Sediment Metals, including Mercury	Field Duplicate/MS/MSD	2/1/1
Sediment SVOCs	Field Duplicate/MS/MSD	2/1/1
Flue Gas PCBs and Dioxins/Furans	Field Duplicate	1
Flue Gas Metals, including Mercury	Field Duplicate	1
Flue Gas SVOCs	Field Duplicate	1
Flue Gas $O_2/CO_2/CO$	Field Duplicate	NA
Condensate PCBs and Dioxins/Furans	Field Duplicate/MS/MSD	1/1
Condensate Metals, including Mercury	Field Duplicate/MS/MSD	1/1
Condensate SVOCs	Field Duplicate/MS/MSD	1/1
Oil Sample	Field Duplicate	NA

Note:

1 MS/MSD analyses should be performed on dried samples

2.6 HEALTH AND SAFETY PLAN

A health and safety plan (HASP), consistent with Hazen's policy, will be developed specifically for working in the Hazen facility on the Holoflite Processor ®.

2.7 INVESTIGATION-DERIVED WASTE MANAGEMENT

Investigation-derived waste (IDW) that will be generated during this project will include disposable soil sampling equipment, decontamination fluids and sludges, and discarded PPE. All disposable soil sampling equipment and decontamination fluids and sludges will be considered solid waste, potentially contaminated and will be containerized in drums. Based on analytical results, containerized soils, liquids and sludges will be disposed of by HRI as solid waste. Discarded PPE will be placed in plastic bags and disposed of by HRI as solid waste material. If, based on analytical results, IDW materials require special handling they will be stored until the completion of the project and shipped offsite for proper disposal.

3.0 TESTING AND MEASUREMENT PROTOCOLS

The QAPP will contain an overview of the sampling program and the laboratory analytical methods requirements.

4.0 QUALITY CONTROL REQUIREMENTS

Field QC samples will be collected and analyzed to assess the quality of field data. A duplicate sample of one of the 8 'before-drying' batches and one of the 8 'after-drying' batches will be analyzed as a field duplicate sample. Because all of the gas stream is required to collect flue gas samples, a QC sample cannot be collected at the same time. Therefore, the 6 flue-gas PCB, SVOCs and 4 flue-gas metals samples will represent replicate samples of the process. The same is true for condensate samples, therefore, no additional QC samples will be obtained and analyzed.

Laboratory QC samples will be analyzed in accordance with referenced analytical method protocols to ensure that laboratory procedures and analyses are conducted properly. The QAPP will contain information concerning field and laboratory QC samples, laboratory control procedures, and field and laboratory equipment testing, inspection, and maintenance requirements. These procedures will be used during the field-sampling effort and during the analytical process to evaluate the validity of the field-sampling effort. If acceptance criteria are exceeded in any QC procedure, the Tetra Tech Project Manager will be contacted by the laboratory.

5.0 PROPOSED SAMPLING SCHEDULE

The following schedule estimate is based on our understanding of the Holoflite Thermal Processor process and physical setup. Until further clarifications can be made, this schedule is only a rough estimate.

FIGURE 5.1 PROPOSED SCHEDULE

DAY	TASKS
0 (Sunday)	Possibly need access to the facility to begin setup.
1 (Monday)	GE/EER set up (about 8 hours) Hazen blending of four drums of waste Tetra Tech sampling of blended waste
2 through 5 (Tuesday through Friday)	(Two to four hours for system to stabilize, one one-hour test run, one fifteen-minute period to prepare for second test run, another one-hour test run, a fifteen-minute rest period, another one-hour test run, system shut down.) Hazen drying blended waste GE/EER performing stack sampling (See Figure 5.2 for details) Tetra Tech to sample sediments, condensate, and oil GE/EER will require three or four hours to recover final samples, pack samples for shipment and disassemble equipment. Tetra Tech will need at least an hour after the last run to collect final samples, package the samples, and clean up. This may have to take place on the morning of Day 6.
6 (Saturday)	Cleanup may take all or part of the morning

FIGURE 5.2 DETAILED TESTING SCHEDULE

(Assuming Residence Time in Dryer is 3 Hours)

DAY	FLUE GAS	CONDENSATE	INFEED & OUTPUT SOLIDS
(Tuesday)			
7 to 10AM			Machine Warmup
10 to 11AM	PCB 1 (1 sample)/Orsat	Run 1 (1 sample)	Batch 1 (Pre-dryer sample)
11 to 11:15AM	Sample Setup		Batch 1 (Post-dryer sample)
11:15 to 12:15PM	PCB 2 (1 sample)/Orsat		
12:15 to 12:30PM	Sample Setup		
12:30 to1:30PM	PCB 3 (1 sample)/Orsat	Run 2 (1 sample)	Batch 2 (Pre-dryer sample)
1:30 to 1:45PM	Sample Setup		Batch 2 (Post-dryer sample)
1:45 to 2:45PM	PCB 4 (1 sample)/Orsat	Run 3 (1 sample)	Batch 3 (Pre-dryer sample)
2:45 to 3:00PM	Sample Setup		Batch 3 (Post-dryer sample)
3:00 to 4:00 PM	PCB 5 (1 sample)/Orsat		
4:00 to 5:00PM			Daily Shutdown
(Wednesday)			
7 to 10AM			Machine Warmup
10 to 11AM	PCB 6 (1 sample)/Orsat	Run 4 (1 sample)	Batch 4 (Pre-dryer sample)
11 to 11:15AM	Sample Setup		Batch 4 (Post-dryer sample)
11:15 to 12:15PM	SVOC 1 (1 sample)/Orsat	Run 5 (1 sample)	Batch 5 (Pre-dryer sample)
12:15 to 12:30PM	Sample Setup		Batch 5 (Post-dryer sample)
12:30 to1:30PM	SVOC 2 (1 sample)/Orsat		
1:30 to 1:45PM	Sample Setup		
1:45 to 2:45PM	SVOC 3 (1 sample)/Orsat	Run 6 (1 sample)	Batch 6 (Pre-dryer sample)
2:45 to 3:00PM	Sample Setup		Batch 6 (Post-dryer sample)
3:00 to 4:00 PM	SVOC 4 (1 sample)/Orsat		
4:00 to 5:00PM			Daily Shutdown

DAY	FLUE GAS	CONDENSATE	INFEED & OUTPUT SOLIDS
(Thursday)			
7 to 10AM			Machine Warmup
10 to 11AM	SVOC 5 (1 sample)/Orsat		
11 to 11:15AM	Sample Setup		
11:15 to 12:15PM	SVOC 6 (1 sample)/Orsat	Run 7 (1 sample)	Batch 7 (Pre-dryer sample)
12:15 to 12:30PM	Sample Setup		
12:30 to 2:30PM	Metals 1 (1 sample)/Orsat		Batch 7 (Post-dryer sample)
2:30 to 2:45PM	Sample Setup		
2:45 to 4:45PM	Metals 2 (1 sample)/Orsat		
4:45 to 5:45PM			Daily Shutdown
(Friday)			
7 to 10AM			Machine Warmup
10 to 12PM	Metals 3 (1 sample)/Orsat		
12 to 12:15AM	Sample Setup		
12:15 to 2:15PM	Metals 4 (1 sample)/Orsat		
2:15 to 2:45PM	Cleanup		System Tear Down
2:45 to 3:45PM			Oil Sample Collection
(Saturday)	Sample Train Cleanup		System Tear Down Cleanup